

GFC-3100 PEM Fuel Cell Hybrid Training System



The principle of a hydrogen PEM fuel cell is to use a proton exchange membrane to generate electricity through an electrochemical reaction between hydrogen and oxygen. In this principle, hydrogen is collected as a source of the fuel cell. The advantage of the hydrogen PEM fuel cell technology is the high efficiency of electricity generation. Moreover, the only byproducts from the fuel cell are heat and water which would not pose any threat to the environment. It meets today's environmental requirements.

The PEM Fuel Cell Hybrid Training System (GFC-3100) provides a modularized teaching platform with a safe and secure experiment environment, in which a user can easily connect a fuel cell with a high-pressure hydrogen cylinder through a rapid joint. The major topics of GFC-3100 exploration include the performance optimization, the energy conversion efficiency of a hydrogen PEM fuel cell, as well as the integration and applications of hydrogen PEM fuel cell technology.

Integrating GFC-3100 PEM Fuel Cell Hybrid Training System and GES-500 Wind and Solar Hybrid System (optional), mixed application of the green energy power generating system can be made, thereby resolving the problem of discontinuous power caused by insufficient wind and solar power. It makes the power generating network more complete and perfect.

● Features

1. An open system architecture & a flexible panel designed for easy replacement of parts
2. A specific fuel-cell database provided for learning and R&D application
3. Data can be displayed and stored in the software
4. Real-time operation status of the system can be observed using a digital meter
5. Safety plugs are equipped with all the input and output terminals for the purpose of easy and safe connection during experiments.
6. Polarity reversal protection is provided to prevent damage from reverse polarity of the supply voltage.
7. An effective and efficient solutions are provided for the fundamental learning of hydrogen PEM fuel cells, the method for storing hydrogen, and related safety norms.



● Specification

GFC-35001 DC Power Supply

1. AC Input Voltage : 90V~240V AC
2. DC Output : adjustable, 10.5V~13.5V DC
3. Power Rated : 75W
4. Output Short Protection
5. With Digital DC Voltage Meter : 4 ½ bits



GFC-35002 Hydrogen Regulator

1. Inlet Pressure Gauge : 0~400psi
2. Outlet pressure Gauge : 0~30psi
3. Adjustable Outlet Pressure
4. Relief Valve Switch



GFC-35003 Hydrogen Flow Meter

1. Flow Meter : 0~2L/min
2. Precision : ±1.5%
3. Max. Pressure : 72.5psi
4. Communication Interface : RS-485
5. With Digital Flow Meter : 4 ½ bits



GFC-35004 100W Fuel Cell Stack

- Quantity of Cell : 20 cells
- Voltage Output : 12V~18V (operating voltage range)
- Rated Power : 100W
- Rated Performance : 12V at 8.3A
- Max. Stack Temperature : 60°C
- Hydrogen Purity : 99.999% dry H₂
- Humidification : self-humidified
- With Temperature Sensor : PT-100



GFC-35005 Fuel Cell Controller

- DC Input Voltage : 12V
- Overheat Protection
- Low Voltage Protection
- Over Current Protection
- Fan Tachometer Control
- Short Control Unit (SCU) Switch
- Purging Valve
- Start Switch



GFC-35006 Fuel Cell DCV/DCA Meter

- Measuring Voltage Range : 0~100V DC, 4 ½ bits
- Measuring Current Range : 0~20A DC, 4 ½ bits
- Communication Interface : RS-485



GFC-35007 Temperature Meter

- Digital Temperature Meter : 0~100°C, 4 ½ bits
- Communication Interface : RS-485



GFC-35008 DC Generator Load Resistor

- Adjustable Wire-Wound Resistor : 1~21Ω
- Power Rated : 200W
- Fuse: 10A



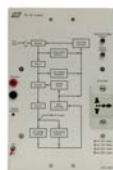
GFC-35009 Digital DCV/DCA Meter & DC-to-DC Converter

- Measuring Voltage Range : 0~100V DC, 4 ½ bits
- Measuring Current Range : 0~20A DC, 4 ½ bits
- DC-to-DC Converter :
Input voltage : 9V~36V DC
Output voltage : 12V DC/10A
Output with fuse protection : 10A
- Communication Interface : RS-485



GFC-35010 DC-AC Inverter

- Power Output : 200W
- Output Waveform : pure sine wave
- Output Voltage : 110V AC, 50Hz/60Hz or 220V AC, 50Hz/60Hz
- Input Voltage : 10V~15V DC, 10A
- Polarity Indicator : reverse supply protection
- Abnormal Voltage Indicator :
Indicator lights up, if DC input < 10V



GFC-35011 AC Load

- LED Bulb : 110V AC or 220V AC, 13W
- AC Fan : 110V AC or 220V AC
- Fuse : 1A



GES-53010 Multifunction Power Meter

- Measuring and Display ACV/ACA/Watt/Frequency/Power Factor/KWH/KWH Time
- Measuring Voltage Range : 80V~260V AC
- Measuring Current Range : 0~15A AC
- Measuring Watt/VA Range : 0~3900W
- Measuring KWH Range : 0~9999KWH
- Measuring Frequency Range : 45Hz~60Hz
- Equipped with a Universal Socket
- Communication Interface : RS-485



GES-53012 DC Load

- LED Bulb : 12V DC, 7W
- DC Fan : 12V DC
- Polarity Indicator : reverse supply protection



List of Experiments

- GFC-3100 Module Introduction and Software Installation
- The Operating Principle of Fuel Cell Stack
- Hydrogen Storage - Theory and Operation
- Activation Experiment
- I-V curve
- Fuel Cell Efficiency Calculation
- Power Densities of Single Cell and Stack Discussion
- DC-to-DC Converter
- Inverter Efficiency
- Fuel Cell and Solar Power System (With optional GES-500A)
- Fuel Cells and Wind Power System (With optional GES-500B)
- Fuel Cells, Wind Power and Solar Power Systems (With optional GES-500)

Accessories



- Experiment Manual
- Connection Leads and Plugs : 1set
- CD : software
- USB to RS-485 Converter
- H₂ Regulator

It is a pressure regulator between high-pressure hydrogen cylinder and GFC-35002.

(1) Inlet connector :

The cylinder connections has 4 types for selection. Confirmation for required type is needed before purchasing.

Gas Connection Assignment Table				
	CGA DISS	CGA	JIS	DIN
Hydrogen	724	350	22-L	DIN1

- (2) Inlet pressure gauge : 0~400bar
- (3) Outlet pressure gauge : 0~16bar



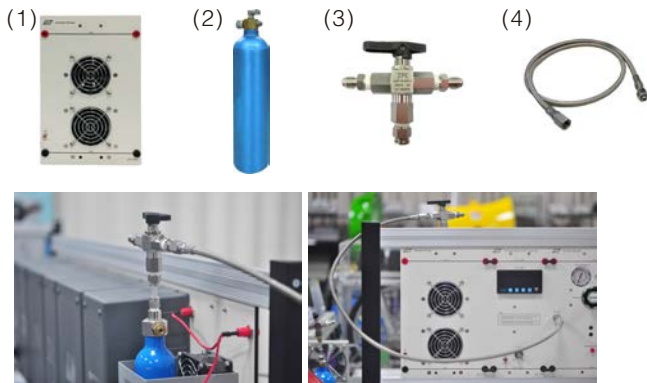
- 6. Rack Frame (KL-89003)



● Optional

Hydrogen Storage (GFC-35021)

- (1) Fan x 2
Input voltage : 12V DC
- (2) Metal hydride canister:
 - a. Hydrogen capacity : 200L ± 5%
 - b. Raw hydrogen purity : ≥ 99.99%
 - c. Charging pressure : ≤ 9.9bar
 - d. Discharging pressure : >0 and ≤ 9.9bar
 - e. Hydrogen purity during discharging : ≥ 99.999%
- (3) Split type 3-way ball valve
- (4) Teflon flexible tube



DC Electronic Load (GFC-39105)

- 1. Voltage Control Range : 0~60V
- 2. Current Control Range : 0~30A
- 3. Output Power : 150W
- 4. 5 Digital V/A/W Meter
- 5. Power ON Status Value Can be Set
- 6. High-speed Measurement and Communication Transmission
- 7. Flexible CC, CR, CV, CP, Dynamic and Short Operation Modes
- 8. V/A/W Values Can be Displayed Simultaneously
- 9. SHORT Time Setting and SHORT_VH, SHORT_VL Setting Function(s)
- 10. LCD Big Display
- 11. Protection Against V, I, W, and °C



- 12. Setting Values Can be Adjusted by Rotary Knob or Push Button
(Setting values are adjustable via the rotary knob or the push button)
- 13. Voltage Meter Displays the Positive ("+") or Negative Polarity Which ("-") is Selectable.
- 14. OCP, OPP Test Function
- 15. Flexible Load Module Configuration
- 16. Include 150 States Store / Recall Memory
- 17. External Recall Key

GES-500 Wind and Solar Hybrid System

GES-500 (Wind and Solar Hybrid System) is composed of Solar Panel, Battery Bank Module, MPPT Solar Charging Controller Module, DC-AC Inverter Module, Grid-tie Inverter Module, Wind Generator Set, Wind Energy Monitor Module, Three-phase Rectifier Module, Wind and Solar Hybrid Controller Module, Load Module and Meters. By means of combining all these control systems, a teaching platform for implementation of the wind power, solar power and hybrid experiments is presented. It can help students understand the theory of on-grid and off-grid solar power, wind power generation system, hybrid system and further create practical applications.

* Excluding GES-53010 and GES-53012 (as they are already included in GFC-3100)



● Consumables

- 1. Proton Exchange Membrane Fuel Cell (20 cells)
- 2. Metal Hydride Canister
- 3. Silicon Tube

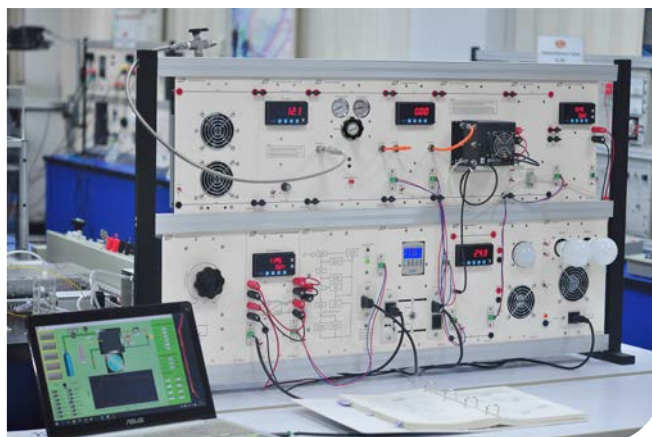
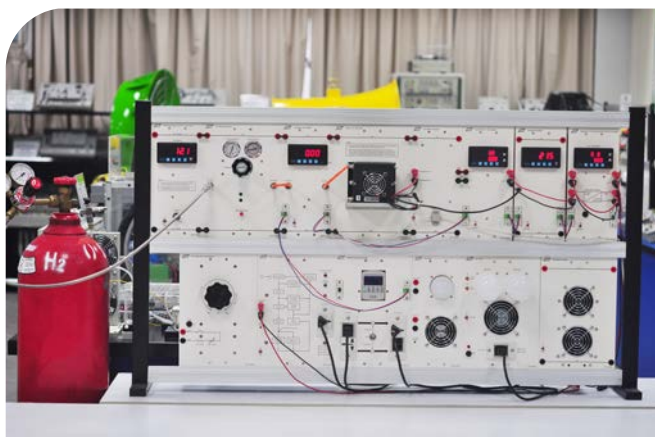
● Requirements

- 1. Hydrogen Purity : 99.99% (It is necessary to prepare locally)
- 2. Personal Computer
- 3. Monkey Spanner x 2

● System Requirement

- 1. PC : 1GHz or faster 32-bit (x86) or 64-bit (x64) processor, 1GB RAM, 1GB more free disk space
- 2. OS : Windows XP / Vista / 7 / 8 / 10

GFC-3100 with GES-500	
Module	Device Name
GFC-35002	Hydrogen Regulator
GFC-35003	Hydrogen Flow Meter
GFC-35004	100W Fuel Cell Stack
GFC-35005	Fuel Cell Controller
GFC-35006	Fuel Cell DCV/DCA Meter
GFC-35007	Temperature Meter
GFC-35009	Digital DCV/DCA Meter & DC-to-DC Converter
GFC-35010	DC-AC Inverter
GFC-35011	AC Load
GES-53010	Multifunction Power Meter
	Optional
GFC-35021	Hydrogen Storage
GES-53001	Wind Energy Monitor
GES-53003	Wind/Solar Hybrid System Controller
GES-53004	Solar Energy/Temperature Meter
GES-53005	MPPT Solar Charging Controller
GES-53009	Battery Bank
GES-58001	Wind Generator Set
GES-58002	Horizontal Axis Wind Turbine
GES-58003	Anemometer
GES-58005	PV Set



GFC-3100 with GES-500A	
Module	Device Name
GFC-35002	Hydrogen Regulator
GFC-35003	Hydrogen Flow Meter
GFC-35004	100W Fuel Cell Stack
GFC-35005	Fuel Cell Controller
GFC-35006	Fuel Cell DCV/DCA Meter
GFC-35007	Temperature Meter
GFC-35009	Digital DCV/DCA Meter & DC-to-DC Converter
GFC-35010	DC-AC Inverter
GFC-35011	AC Load
GES-53010	Multifunction Power Meter
	Optional
GFC-35021	Hydrogen Storage
GES-53004	Solar Energy/Temperature Meter
GES-53005	MPPT Solar Charging Controller
GES-53009	Battery Bank
GES-58005	PV Set

GFC-3100 with GES-500B	
Module	Device Name
GFC-35002	Hydrogen Regulator
GFC-35003	Hydrogen Flow Meter
GFC-35004	100W Fuel Cell Stack
GFC-35005	Fuel Cell Controller
GFC-35006	Fuel Cell DCV/DCA Meter
GFC-35007	Temperature Meter
GFC-35009	Digital DCV/DCA Meter & DC-to-DC Converter
GFC-35010	DC-AC Inverter
GFC-35011	AC Load
GES-53010	Multifunction Power Meter
	Optional
GFC-35021	Hydrogen Storage
GES-53001	Wind Energy Monitor
GES-53003	Wind/Solar Hybrid System Controller
GES-53009	Battery Bank
GES-58001	Wind Generator Set
GES-58002	Horizontal Axis Wind Turbine
GES-58003	Anemometer